1975 AND 1976 GREAT LAKES CURRENT AND WATER QUALITY METER DATA SUMMARY

Ministry of the Environment
rio

1975 AND 1976

GREAT LAKES

CURRENT AND WATER QUALITY METER

DATA SUMMARY

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1975 and 1976 Great Lakes Current and Water Quality Meter Data Summary

This data summary obtained from operations involving automatic chemistry and current measuring devices deployed by the Water Resources Branch of the Ontario Ministry of the Environment during 1975-76 is the 2nd in a series of reports listing the available data, their condition, and the methods and procedures involved in securing and processing the data into the form of a data bank. The processed data are available to interested agencies.

In 1975, the areas of attention regarding water currents were Toronto and Hamilton Harbours on Lake Ontario, Nanticoke on Lake Erie, and one installation in Thunder Bay on Lake Superior (Figures 2, 3, 5, 6 respectively). The following year all meter installations except one (St. Lawrence River at Gananoque - Figure 1) were in Hamilton Harbour with 4 levels being monitored within the Burlington Canal.

During 1975-76 the water quality of Toronto Harbour was recorded on a continuous basis at 3 sampling sites (Keating Channel, East Gap, West Gap - Figure 2) by shore-mounted instruments (Schneider Robot Monitors). In addition, short 6-8 hour runs at 2 or 10 minute cam settings were carried out at 3 other locations using a Nera Robot Monitor. A two layer 10 day intensive sampling run was carried out in 1975 at Nanticoke (Figure 5) during which 6 parameters were recorded every 1/2 hour. In 1976 deployment of the Nera was restricted to a profiling mode exclusively. A comprehensive weekly sampling program of a grid network in Hamilton Harbour (Figure 4) was initiated with measurements taken at every meter. The data were deemed necessary as a complement to the ongoing artificial mixing program and experiments conducted by personnel from McMaster University.

All the data presented in this report are available on computer tape in a smoothed condition and are accessible through the appropriate FORTRAN program. Data requests should be directed to:

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Current Meters

At present, the operational inventory of recording current meters consists of 8 PLESSEY MO21's, 6 geodyne 102's, 2 geodyne 850's and 4 geodyne 920's. The technical specifications of each of these types of meters e.g. sensor type, threshold velocity (range and accuracy), compass resolution, recording medium and code are presented in Table 3. The quoted figures were supplied for the most part by the respective manufacturer and in some instances do not reflect changes due to modifications.

To insure maximum data return, all meters are subjected to thorough pre-and past-mooring electronic checks plus an environmental chamber

test to simulate in situ conditions. This meter maintenance program was carried out by Genelcom Limited (geodyne 920, 850, Plessey MO21) and George Kelk Limited (geodyne 102).

Water Quality Meters

A listing of water chemistry measuring instruments is presented in Table 4. Besides the number of each type, the range and accuracy of each parameter, power sources, recording medium and code are included. The sensor circuit accuracies listed are considered conservative due to considerable electronic updating, redesigned sensors and introduction of the latest solid state components.

The type of required power source of each instrument dictates the location flexibility. Shore power (115VAC) is required for the Schneider Robot Monitor, and as such they are limited to shipping canals or locations where a continuous sample can be pumped past the sensors from the watercourse. Data return tends to be much higher and more accurate than submerged instruments due to constant monitoring, sensor cleaning and routine electronic adjustments.

The Plessey WQM IV is a self-contained instrument which can be secured at any depth (sensor limit-33m) at any location. Six parameters can be monitored at 1/2-or 1-hour intervals and a small pump provides adequate flow through the sensor block. Past performance has been disappointing due to sensor electronic failures, sensor fouling and unsuitable recording signal.

The Nera Environmental monitor was initially deployed on a secured surface float with the sensor sonde at the desired depth. Disastrous results due to floatation problems curtailed its use in this mode, and the 2 instruments have been reserved strictly for profiling.

All water quality meters are calibrated before, during (Schneider) and after installation by MOE personnel, with volume samples being taken in situ on a regular basis for lab analysis to check data accuracy.

Meter Installations

During 1975 and 1976 all installations were of the submerged floatation drum variety with the exception of Burlington Canal. In the submerged floatation drum configuration, the meter is attached to the taught cable between the drum (10 gallon foam-filled steel) and its anchors. An aluminum spar in scientific colours marks all meter locations.

In 1975 the current meter installation in Burlington Canal was changed from a submerged tower to a taught wire configuration with a 3,000 lb. steel pod resting on the north wall with two steel tubular projections out over the water. Stainless steel cable from the projection terminals is secured to anchors on the bottom. This type of installation allows placement of instrumentation anywhere in the water column and provides minimal horizontal deflection.

Current Meter Data Summary

Tables 1 and 2 present a record of information pertaining to each installation during 1975 and 1976 respectively. Period and length of record, depth, recording interval, meter type, location, support system employed and temperature availability are included.

A statistical summary of current meter operations for 1975 in Toronto Harbour, Hamilton Harbour and Nanticoke is presented in Tables 5, 6, and 7 respectively. Data listed are resultant direction and speed, average and maximum speed, persistence, percentage of negligible speed, time going in direction of resultant, number of readings and recording interval. It is noted that negligible speed was taken to be speeds less than 0.3 cm. s^{-1}. Table 8 contains a data summary for 1976 of currents in Hamilton Harbour and the Burlington Canal.

Water Chemistry Data Summary

In 1975, both Nera monitors were housed in a surface float at Nanticoke for an 11-day period in early June, monitoring several parameters at two depths (0.80m; 3.31m). The daily means and standard deviations for each parameter per day are itemized in Tables 9a and 9b. Tables 10 and 11 contain data from Toronto Harbour for 1975 and 1976 respectively. Instrument type for each location is indicated along with means and st. dev. for chloride (1 location), temperature, dissolved oxygen, turbidity, redox potential, pH and conductivity. The two sampling sites at Canada Malting and Queen Elizabeth Docks were monitored over 6 hour periods at 10 and 2 minute intervals on November 13 and November 24 respectively. In 1976 the same locations plus the mouth of the turning basin (Figure 2) were sampled for 8 hour periods at 10 minute intervals.

A comprehensive weekly monitoring program was instituted in 1976 on a 4 station network in Hamilton with measurements taken every meter in the water column using the Nera monitor. Table 12 gives the sampling dates along with the parameters available. On several occasions an expanded station grid was also sampled (Figure 4). Parameter summaries for each of the four stations (270, 258, 4, 252) consisting of mean, st. dev. and number of samples for each depth per season are listed in Tables 13, 14, 15 and 16 respectively.

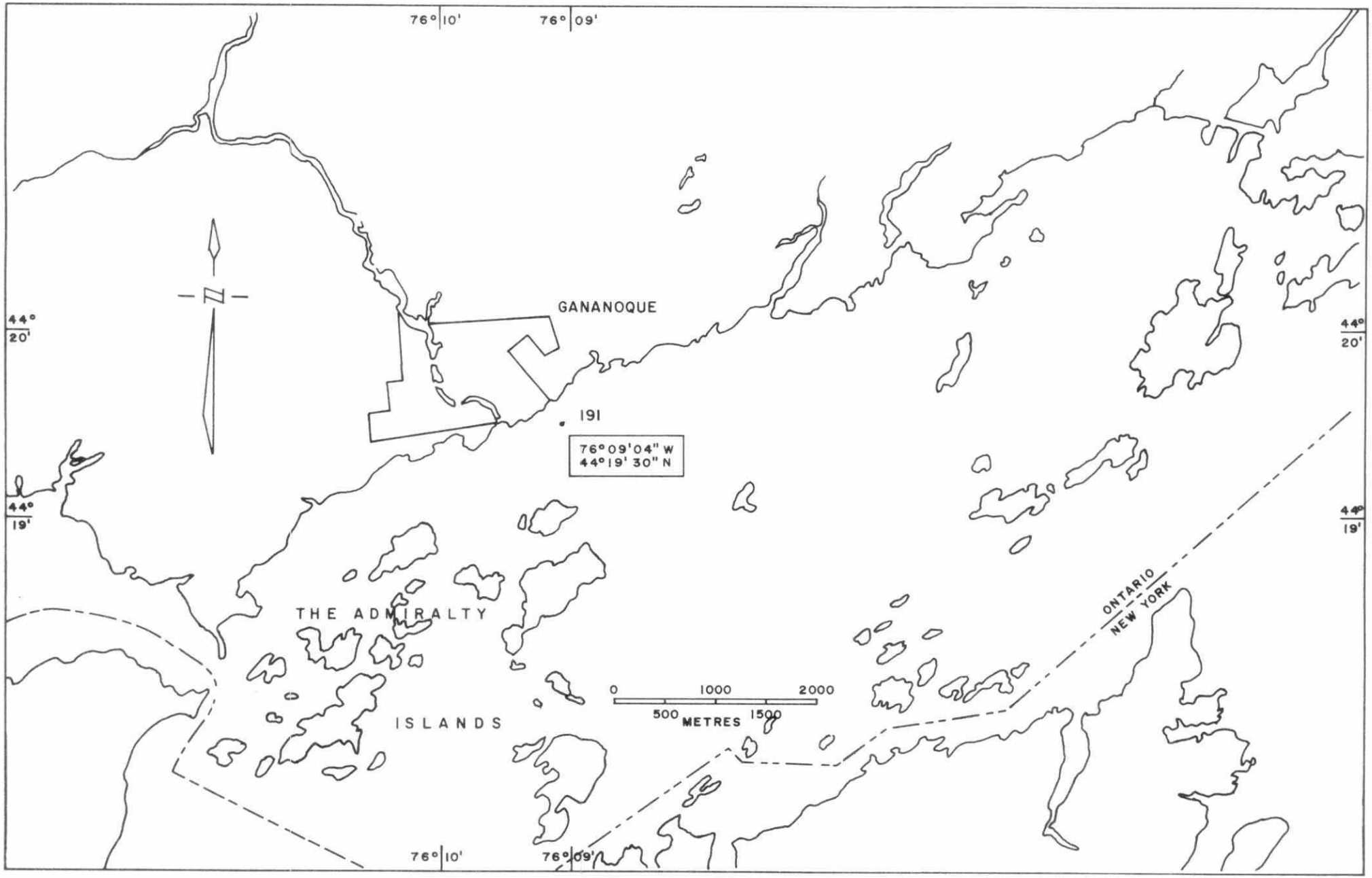

FIGURE I CURRENT METER LOCATION, ST. LAWRENCE RIVER, 1976.

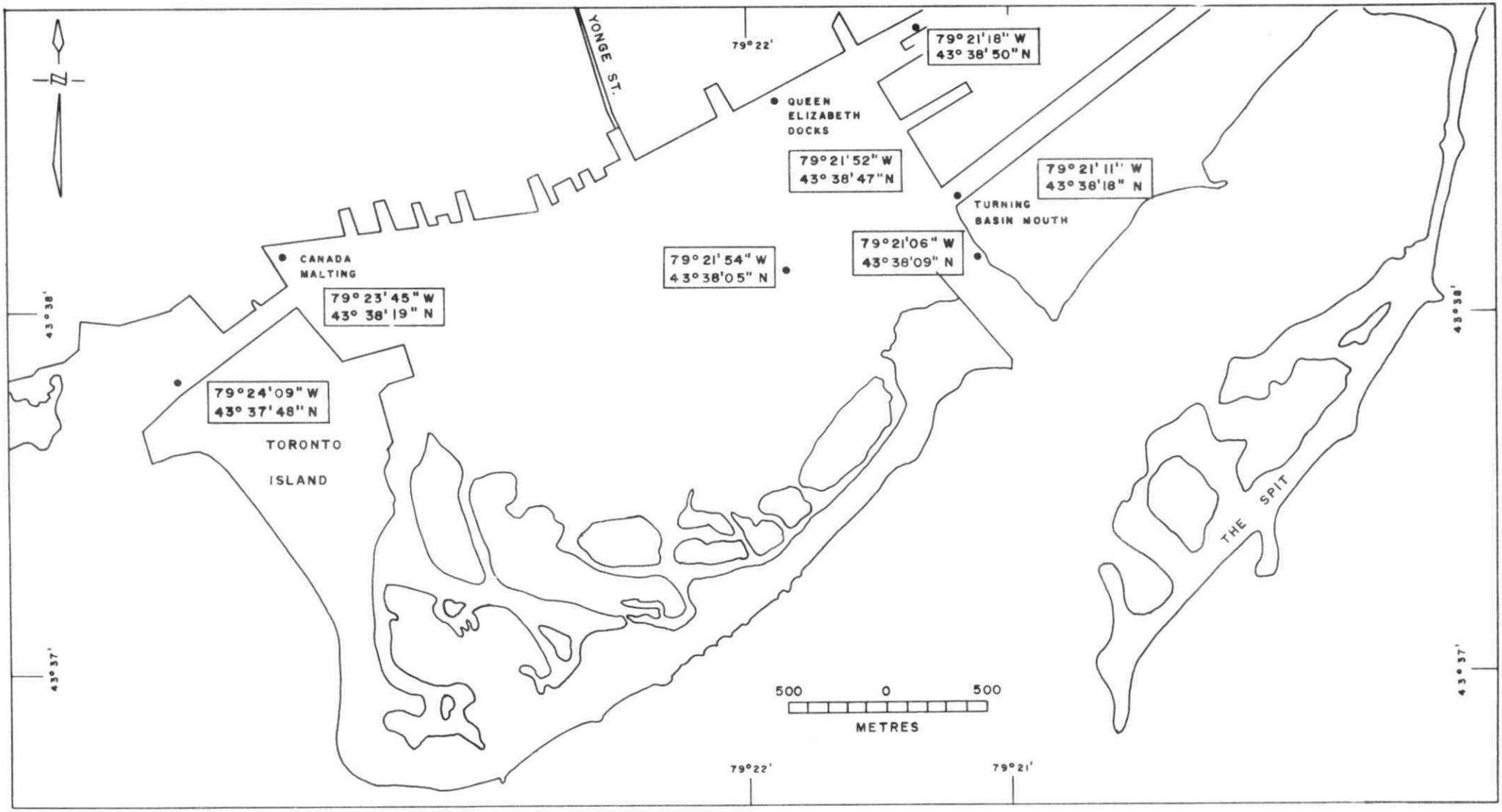

FIGURE 2 LOCATION OF WATER CHEMISTRY MONITOR SITES AND CURRENT METER LOCATIONS, TORONTO HARBOUR, 1975-76.

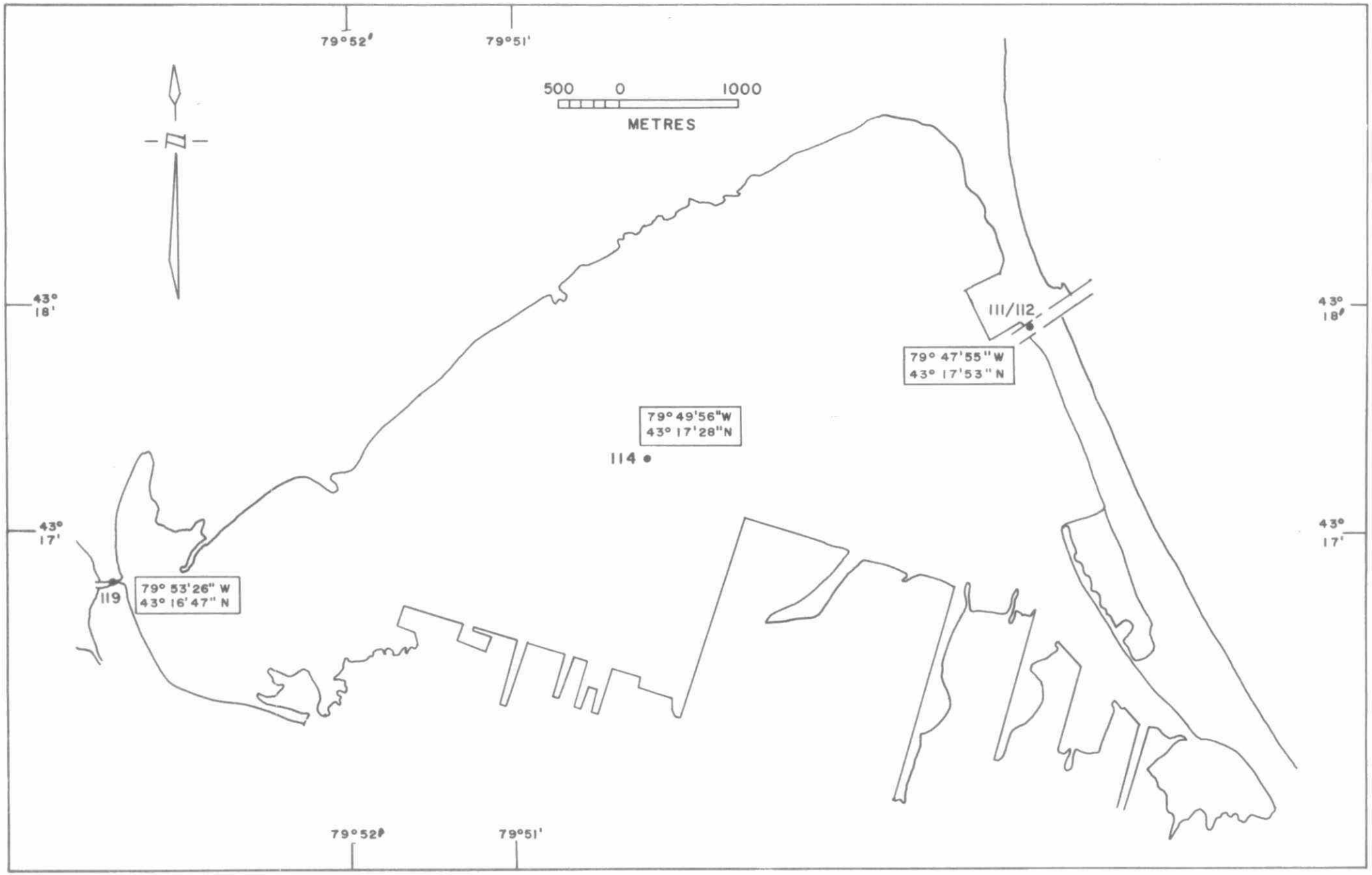

FIGURE 3 CURRENT METER LOCATIONS, HAMILTON HARBOUR, 1975-76.

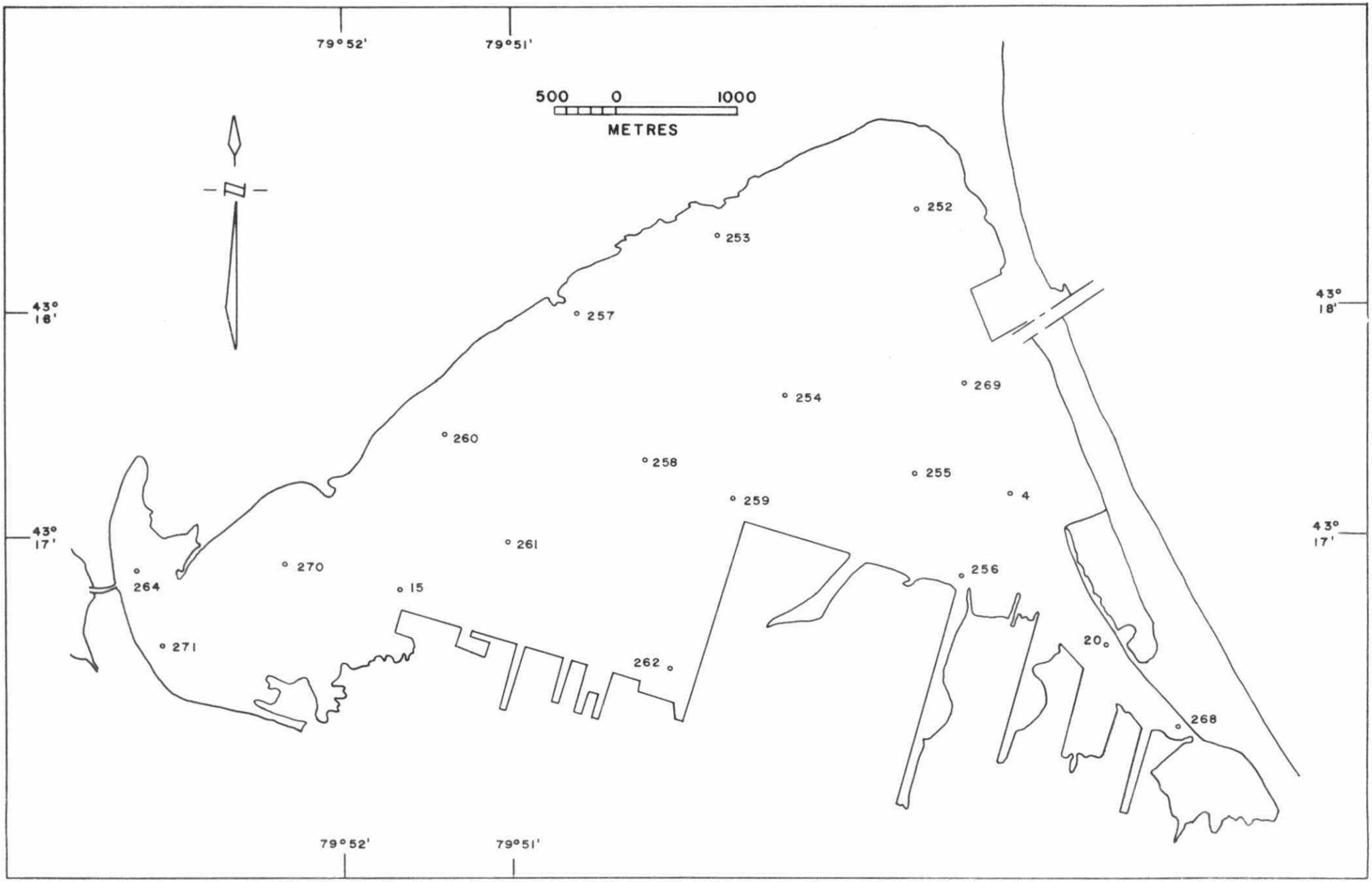

FIGURE 4 NERA PROFILE LOCATIONS, HAMILTON HARBOUR, 1976.

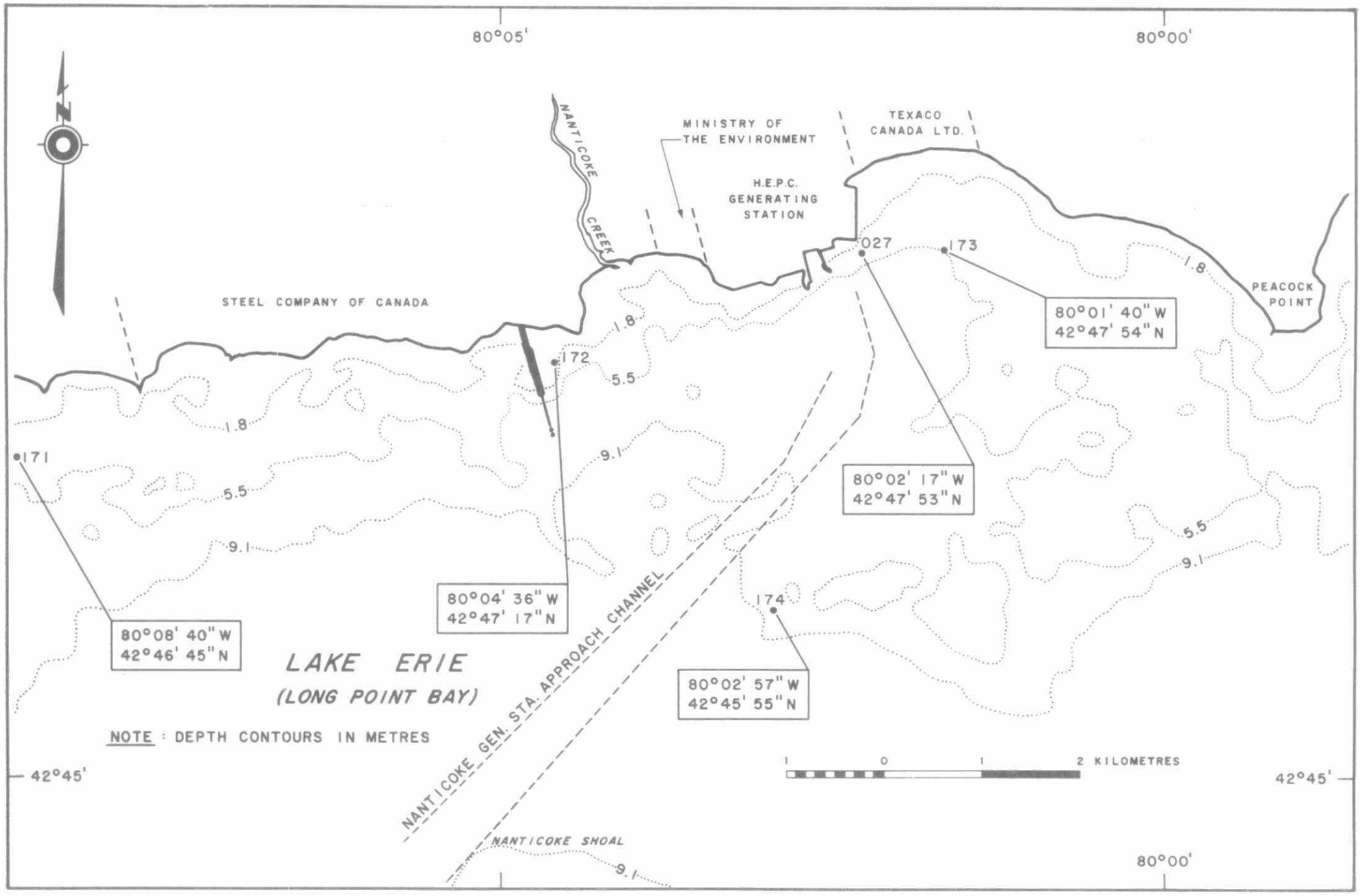

FIGURE 5 - WATER QUALITY AND CURRENT METER LOCATIONS, NANTICOKE, LAKE ERIE, 1975-76.

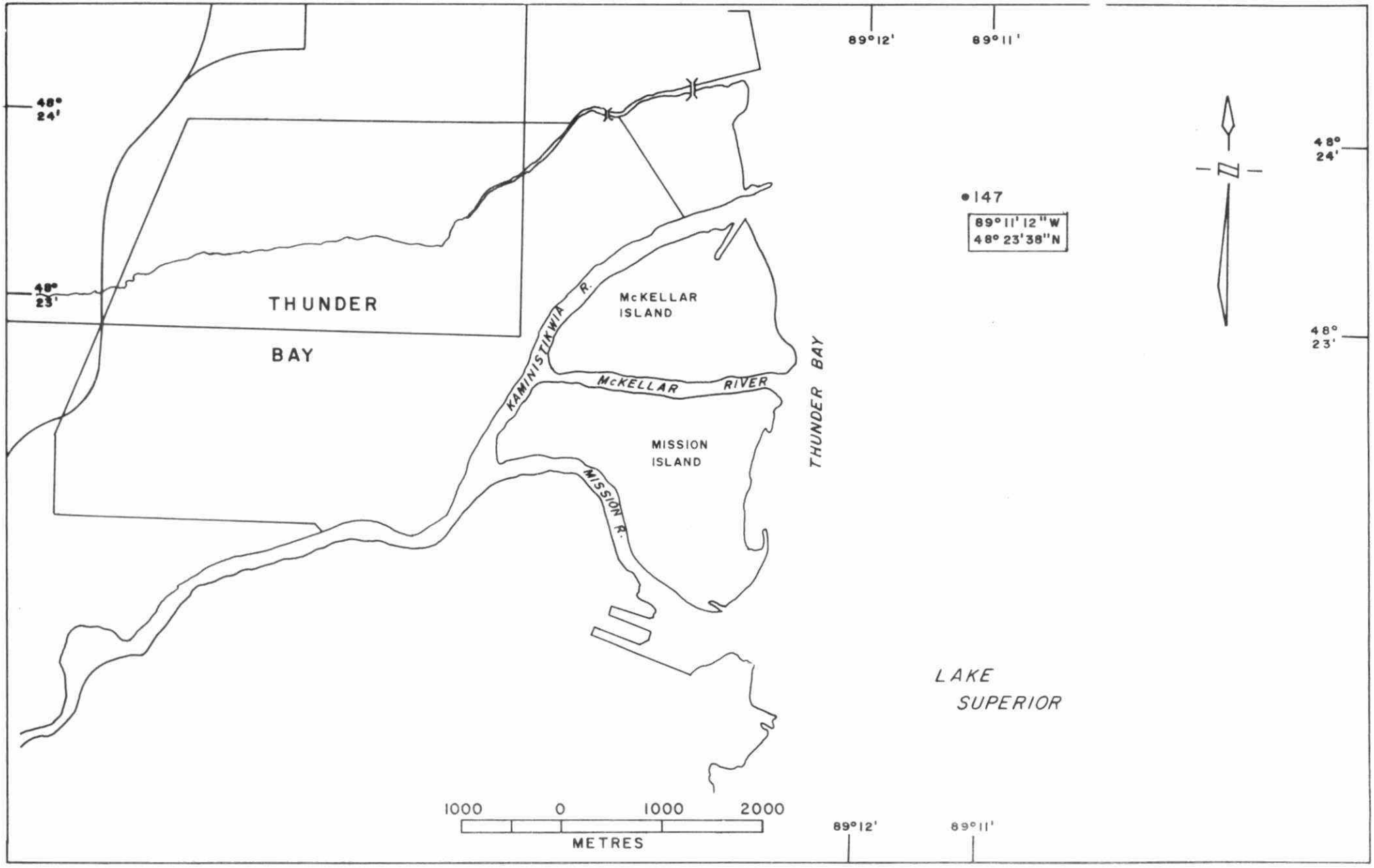

FIGURE 6 CURRENT METER LOCATION, THUNDER BAY, 1975.

TABLE 1 CURRENT METER LOG 1975

Tape No.	Body of Water	Location	Meter Type	CAM Setting Min.	Support System	Data Length Days	Temperature	Total Depth m	Depth From Bottom m	Meter Installed	Meter Removed
12501	L. Ontario	Toronto H. East Gap	Plessey MO21	10	Sub. Float	64	Available	6.7	3.4	Sept. 23	Nov. 26
12601	L. Ontario	Toronto H. West Gap	Plessey MO21	10	Sub.Float	50	Available	9.8	4.9	Sept. 23	Nov. 12
12901	L. Ontario	Toronto H. Harb. East	Geo.102	20	Sub. Float	80	No sensor	7.9	2.4	Sept. 24	Dec. 13
11101	L. Ontario	Burlington Canal	Plessey MO21	10	Taught Wire	45	Available	9.4	6.1	Aug. 14	Sept. 28
111A01	L. Ontario	Burlington Canal	Plessey MO21	10	Taught Wire	45	Available	9.4	7.5	Aug. 14	Sept. 28
11401	L. Ontario	Hamilton H.	Geo. 850	10	Sub. Float	59	unreliable	22.9	16.3	Aug. 6	Oct. 4
14701	L. Superior	Thunder Bay	Geo. 102	20	Sub. Float	125	No Sensor	12.8	7.0	June 12	Oct. 15
17101	L. Erie	Nanticoke	Geo. 920	10	Sub. Float	46	Available	7.0	3.0	May 8	June 23
17102	L. Erie	Nanticoke	Geo. 920	10	Sub. Float	52	Available	7.0	3.0	Sept. 19	Nov. 10
17201	L. Erie	Nanticoke	Geo. 920	10	Sub. Float	51	Available	5.8	2.7	May 8	July 28
17202	L. Erie	Nanticoke	Geo. 920	10	Sub. Float	61	Available	5.8	2.7	Sept. 19	Nov. 19
17301	L. Erie	Nanticoke	Plessey MO21	20	Sub. Float	53	Available	7.9	3.0	May 8	June 30
17302	L. Erie	Nanticoke	Plessey MO21	10	Sub. Float	61	Available	7.9	3.0	Sept. 19	Nov. 19
17401	L. Erie	Nanticoke	Plessey MO21	20	Sub. Float	61	Unreliable	9.1	4.0	May 8	July 8
17402	L. Erie	Nanticoke	Plessey MO21	10	Sub. Float	61	Available	9.1	4.0	Sept. 19	Nov. 19

TABLE 2 CURRENT METER LOG 1976

Tape No.	Body of Water	Location	Meter Type	CAM Setting Min.	Support System	Data Length Days	Temperature	Total Depth m	Depth From Bottom m	Meter Installed	Meter Removed
11101	L. Ontario	Burlington Canal	Plessey M021	10	Taught Wire	81	Available	9.8	4.6	June 2	Aug. 23
11102	L. Ontario	Burlington Canal	Plessey M021	10	Taught Wire	55	Available	9.8	4.6	Sept. 30	Nov. 25
111A01	L. Ontario	Burlington Canal	Plessey M021	10	Taught Wire	81	Available	9.8	7.1	June 2	Aug. 23
111A02	L. Ontario	Burlington Canal	Plessey M021	10	Taught Wire	55	Unavailable	9.8	7.1	Sept. 30	Nov. 25
11201	L. Ontario	Burlington Canal	Plessey M021	10	Taught Wire	37	Available	9.8	1.2	June 2	Aug. 23
112A01	L. Ontario	Burlington Canal	Plessey M021	10	Taught Wire	81	Available	9.8	8.3	June 2	Aug. 23
112A02	L. Ontario	Burlington Canal	Plessey M021	10	Taught Wire	54	Available	9.8	8.3	Sept. 30	Nov. 25
11401	L. Ontario	Hamilton Harbour	Geo.920	10	Sub. Float	76	Available	22.9	16.3	June 8	Aug. 23
11901	L. Ontario	Hamilton Harbour	Geo 920	10	Sub. Float	89	Available	3.7	1.8	May 26	Aug. 23
11902	L. Ontario	Hamilton Harbour	Geo.920	10	Sub. Float	81	Available	3.7	1.8	Sept. 3	Nov. 24
19101	St.Lawrence River	Gananoque	Plessey	10	Sub. Float	64	Available	9.4	4.0	Aug. 19	Oct. 27

TABLE 3: CURRENT METER TECHNICAL SPECIFICATIONS

Type (Units)	Parameters	Velocity and Direction Sensors	Threshold Velocity cm/s	Velocity Range and Accuracy	Compass Resolution	Recording Medium	Recording Code
Plessey M021 (10)	Velocity Direction Temperature	Propellor and Vane	3.0	3.0-250 cm/s ± 3% or 3 cm/s whichever is greater	2^{o}	Reel-Reel 1/4" Mag. Tape	Binary
Geodyne 850 (2)	Velocity Direction	Savonius Rotor and Vane	0.5	0.5-103 cm/s within 2.57 cm/s for speeds <51.4 cm/s	2.8^{o}	Mag Tape endless-Loop cartridge	Gray Binary
Geodyne 920 (4)	Velocity Direction Temperature	Savonius Rotor and Vane	0.5	0.5-103 cm/s within 2.57 cm/s for speeds <51.4 cm/s	2.8^{o}	Mag Tape Endless-Loop Cartridge	Gray Binary
Geodyne 102 (6)	Velocity Direction	Savonius Rotor and Vane	0.5	0.5-103 cm/s within 2.57 cm/s for speeds <51.4 cm/s	2.8^{o}	16 MM Film XX Neg.	Gray Binary

TABLE 4 WATER QUALITY METER TECHNICAL SPECIFICATIONS

Type (Units)	Parameters	Range	Accuracy	Power Source	Instrument Attitude	Recording Medium	Recording Code
Plessey W.Q.M. IV (1)	Temperature	0-30°C	±0.3°C	2 rechargeable NICAD batteries 1-18V(+); 1-18V(-) depth 33m	completely self contained; sensors at depth; max. depth 33m	Tape Cassette 1/4" Mag.	Binary
	DO	0-130% sat.	±5%				
	pH	4-10 SU	±0.2 SU				
	Cond.	10-1,000 umhos/cm	±3.2 at 10 ±4.2 at 1000				
	Turb.	0-100 ppm	±1.5 ppm at 0 ±10 ppm at 100				
	Pressure	0-500 kPa	±2%				
Nera Environmental Monitor (2)	Temperature	-5°C-+45°C	±0.25°C	1 rechargeable 12 V neg. battery	electronics package is surface or shore mounted; sensors at depth; max. depth 30m	Tape Cassette	ASC11
	DO	0-20 ppm	±2%				
	pH	2-12 SU	±0.1 SU				
	ORP	0-1000 mV	±5 mV				
	Cond.	0-1000 umhos/cm	±0.5% of range				
	Depth	0-20M	±2% of range				
Schneider Robot Monitor (3)	Temperature	0-120°F	±1/2% of range	110 VAC	electronics module and sensors are shore mounted. Sample pumped to sensors	Punched Paper Tape	IBM BCD
	DO	0-24 mg/l					
	pH	0-14 SU					
	Cond.	0-1200 umhos/cm					
	Turb.(2)	0-48 FTU					
	Chloride (1)	0-600 ppm					

TABLE 5 TORONTO HARBOUR 1975

STATISTICAL SUMMARY OF CURRENT METER OPERATIONS

	LOCATION									
	125 (East Gap)			126 (West Gap)			129 (Harbour)			
	Sept.	Oct.	Nov.	Sept.	Oct.	Nov.	Sept.	Oct.	Nov.	Dec.
Resultant direction coming from 0° as North	311	313	125	242	243	244	58	250	253	249
Resultant speed $cm.s^{-1}$	1.71	2.23	2.02	2.90	4.55	7.09	1.13	1.40	2.38	2.84
Average speed $cm.s^{-1}$	3.09	3.67	2.39	6.58	7.06	8.37	3.82	2.52	3.58	4.17
Maximum speed $cm.s^{-1}$	15.31	26.18	26.71	20.70	25.05	40.39	35.59	38.97	39.70	39.98
Persistence Factor	0.55	0.61	0.85	0.44	0.64	0.85	0.30	0.56	0.67	0.68
Percentage of neglibible** speed (% of recording period)	9	6	26	3	2	1	16	32	34	18
Percentage of time going in direction of resultant	28	36	29	33	36	40	10	32	32	33
Total number of readings	1008	4464	3694	1008	4464	1626	504	2232	2160	875
Interval of readings (mins)	10	10	10	10	10	10	10	10	10	10

** <0.3 $cm.s^{-1}$

TABLE 6 HAMILTON HARBOUR 1975

STATISTICAL SUMMARY OF CURRENT METER OPERATIONS

	LOCATION						
	111		111 A		114		
	Aug.	Sept.	Aug.	Sept.	Aug.	Sept.	Oct.
Resultant direction coming from 0° as North	41	255	260	252	337	304	77
Resultant speed $cm.s^{-1}$	1.02	1.76	6.17	3.27	0.59	0.48	0.76
Average speed $cm.s^{-1}$	8.31	7.94	11.78	8.23	2.24	0.84	1.05
Maximum speed $cm.s^{-1}$	44.51	44.23	46.50	44.94	11.13	9.69	5.38
Persistence Factor	0.12	0.22	0.52	0.40	0.26	0.57	0.73
Percentage of neglibible** speed (% of recording period)	5	20	2	20	24	52	53
Percentage of time going in direction of resultant	32	24	49	36	14	10	46
Total number of readings	2588	4309	2591	3965	3600	4320	436
Interval of readings (mins)	10	10	10	10	10	10	10

** < 0.3 $cm.s^{-1}$

TABLE 7 (OFFSHORE OF NANTICOKE, LAKE ERIE, 1975)
STATISTICAL SUMMARY OF CURRENT METER OPERATIONS

	LOCATION										
	171					172					
	PERIOD										
	May	June	Sept.	Oct.	Nov.	May	June	July	Sept.	Oct.	Nov.
Resultant direction coming from 0° as North	204	157	98	100	323	90	113	284	98	101	90
Resultant speed ($cm.s^{-1}$)	3.32	0.18	3.11	1.34	3.85	2.10	0.79	1.90	4.06	4.30	11.25
Average speed ($cm.s^{-1}$)	12.01	12.54	11.24	10.26	5.15	5.89	6.93	1.99	11.76	11.42	13.83
Maximum speed ($cm.s^{-1}$)	26.73	18.75	29.19	37.33	18.92	18.59	25.31	14.87	37.99	37.64	56.87
Persistence Factor	0.28	0.01	0.28	0.13	0.75	0.36	0.11	0.96	0.35	0.38	0.81
Percentage of neglibible* speed (% of recording period)											
Percentage of time going in direction of resultant	17	8	44	31	46	40	15	48	58	50	71
Total number of readings	3311	3174	1584	4464	1439	3312	4320	3898	1584	4464	2692
Interval of readings (mins)	10	10	10	10	10	10	10	10	10	10	10

* < 0.30 cm.s-1

TABLE 7 continued

	LOCATION										
	173					174					
	PERIOD										
	May	June	Sept.	Oct.	Nov.	May	June	July	Sept.	Oct.	Nov.
Resultant direction coming from 0° as North	229	224	271	260	274	264	267	276	276	290	290
Resultant speed ($cm.s^{-1}$)	1.34	4.28	2.71	2.20	4.06	2.80	2.59	4.38	3.02	1.82	7.09
Average speed ($cm.s^{-1}$)	5.50	8.76	3.99	3.69	4.81	4.16	3.90	5.06	6.68	5.68	8.28
Maximum speed ($cm.s^{-1}$)	33.71	31.68	20.66	16.46	23.85	16.46	23.85	14.69	22.39	32.48	43.24
Persistence Factor	0.24	0.49	0.68	0.60	0.84	0.67	0.65	0.87	0.45	0.32	0.86
Percentage of negligible* speed (% of recording period)	11	3	7	11	6	9	9	6	3	5	5
Percentage of time going in direction of resultant	24	36	41	29	44	37	30	52	49	25	35
Total number of readings	3311	4200	1584	4464	2573	3311	4320	1103	1584	4464	2619
Interval of readings (mins)	10	10	10	10	10	10	10	10	10	10	10

* $<0.30\ cm.s^{-1}$

TABLE 8 (HAMILTON HARBOUR 1976)
STATISTICAL SUMMARY OF CURRENT METER OPERATIONS

	LOCATION																				
	111A			112A			1110			111A		112A		1110		1190			1140		
	June	July	Aug.	June	July	Aug.	June	July	Aug.	Oct.	Nov.	Oct.	Nov.	Oct.	Nov.	Sep.	Oct.	Nov.	June	July	Aug.
Resultant direction coming from 0° as North	263	266	265	257	258	261	258	261	271	241	226	255	220	261	259	92	93	86	24	5	338
Resultant speed cm.s^{-1}	5.0	5.9	3.6	8.6	11.6	6.8	1.0	0.6	1.0	3.7	2.3	4.9	0.9	2.6	1.6	13.7	8.1	6.7	0.9	1.8	1.3
Average speed cm.s^{-1}	11.9	9.3	7.8	13.5	13.7	10.3	10.5	6.9	7.1	10.5	10.4	12.0	9.8	10.7	10.8	24.2	21.8	23.7	4.8	4.6	3.7
Maximum speed cm.s^{-1}	129	56	48	83	54	49	126	50	44	77	52	75	49	79	50	85	79	70	15	16	10
Persistence factor	0.42	0.64	0.46	0.64	0.85	0.66	0.09	0.09	0.14	0.35	0.22	0.40	0.09	0.24	0.14	0.57	0.37	0.28	0.18	0.38	0.34
Percentage of negligible* speed (% of recording period)	1	5	2	1	0	0	1	4	2	2	1	1	1	2	1	7	0	0	0	0	0
Percentage of time going in direction of resultant	57	65	54	69	81	68	39	41	44	27	9	40	4	50	47	33	36	41	13	20	21
Total number of readings	4032	4464	3239	4032	4464	3189	4032	4464	3190	4464	3528	4320	3478	4464	3478	3892	4467	3386	3168	4463	3241
Interval of readings (mins)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

* <0.3 cm.s^{-1}

TABLE 9a
NANTICOKE - LAKE ERIE 1975
WATER CHEMISTRY SUMMARY STATION #027
DAILY MEANS STARTING AT 12.25 HR. ON GIVEN DATE

Y.M.D.		DEPTH (m)	TEMP (°C)	D.O. (mg/l)	D.O. (% sat.)	REDOX (mV)	pH	COND (25°C)	NO. OF READINGS
750528	Mean	0.80	13.96	12.15	121.64	*	*	*	49
	St.Dev.	0.23	6.97	0.78	29.22				
750529	Mean	0.90	10.08	11.42	100.96	209.37	8.24	279.96	48
	St.Dev.	0.08	0.84	0.20	2.09	10.83	0.09	4.07	
750530	Mean	0.77	11.31	11.42	104.05	188.38	8.19	279.79	48
	St.Dev.	0.03	0.92	0.16	2.81	21.87	0.06	3.60	
750531	Mean	0.77	11.08	11.19	101.32	225.00	8.15	275.10	48
	St.Dev.	0.02	0.52	0.21	1.99	15.92	0.10	5.71	
750601	Mean	0.74	10.35	11.85	100.89	161.69	8.45	269.65	48
	St.Dev.	0.15	0.94	0.63	2.31	105.45	0.60	5.77	
750602	Mean	0.79	12.56	11.06	103.74	230.36	7.99	267.81	48
	St.Dev.	0.06	0.59	0.32	3.42	10.85	0.09	7.35	
750603	Mean	0.66	12.87	11.07	102.11	*	*	*	48
	St.Dev.	0.15	1.50	0.44	4.74				
750604	Mean	0.66	12.26	10.66	99.24	246.27	7.91	256.60	48
	St.Dev.	0.07	0.54	0.35	3.25	9.17	0.08	6.17	
750605	Mean	0.56	12.77	10.25	96.63	239.23	7.82	248.88	48
	St.Dev.	0.03	0.82	0.20	1.99	7.11	0.08	5.57	
750606	Mean	0.60	10.78	10.29	92.46	243.69	7.73	232.96	48
	St.Dev.	0.05	1.29	0.38	2.59	11.62	0.09	15.48	
750607	Mean	0.96	16.04	10.15	102.04	*	*	*	34
	St.Dev.	0.43	13.31	0.75	19.36				
Grand Mean		0.74	12.06	11.05	102.42	201.42	8.14	308.30	515
St.Dev.		0.19	4.25	0.75	12.66	73.28	0.51	174.51	

*Equipment Malfunction - Redox, pH and Conductivity values are invalid.

TABLE 9b
NANTICOKE - LAKE ERIE 1975
WATER CHEMISTRY SUMMARY STATION #027
DAILY MEANS STARTING AT 12.25 HR. ON GIVEN DATE

Y.M.D.		DEPTH (m)	TEMP (°C)	D.O. (mg/l)	D.O. (% sat.)	REDOX (mV)	pH	COND (25°C)	NO. OF READINGS
750528	Mean	3.31	6.53	12.33	100.37	254.98	8.22	285.72	
	St.Dev.	0.07	0.44	0.16	1.42	11.20	0.03	1.34	49
750529	Mean	3.14	9.35	11.82	102.92	262.49	8.20	287.95	
	St.Dev.	0.05	0.36	0.18	1.50	7.98	0.03	1.05	48
750530	Mean	3.12	9.87	11.93	105.09	264.02	8.19	288.95	
	St.Dev.	0.06	0.58	0.17	1.32	14.58	0.08	1.03	48
750531	Mean	3.09	10.06	11.77	104.05	268.90	8.15	289.65	48
	St.Dev.	0.03	0.92	0.18	2.42	9.27	0.04	1.05	
750601	Mean	3.18	9.46	11.84	103.70	275.40	8.15	289.63	48
	St.Dev.	0.04	0.47	0.17	1.50	3.65	0.04	1.14	
750602	Mean	3.19	10.09	11.98	106.49	279.10	8.19	289.54	48
	St.Dev.	0.08	0.59	0.19	1.92	4.84	0.06	1.08	
750603	Mean	3.10	10.36	11.98	106.91	274.47	8.17	289.73	48
	St.Dev.	0.06	0.50	0.19	1.79	4.78	0.04	1.04	
750604	Mean	2.89	12.59	11.29	105.61	277.60	8.20	289.42	48
	St.Dev.	0.19	1.35	0.54	2.28	3.68	0.04	1.33	
750605	Mean	2.75	13.28	10.91	103.78	280.65	8.21	289.06	48
	St.Dev.	0.04	0.54	0.17	1.06	3.69	0.04	1.33	
750606	Mean	2.86	11.66	11.12	102.00	281.88	8.18	291.95	48
	St.Dev.	0.07	1.36	0.37	1.39	5.55	0.03	1.32	
750607	Mean	3.07	8.61	11.40	97.33	285.70	8.10	292.55	34
	St.Dev.	0.06	0.65	0.17	2.77	6.14	0.07	1.37	
Grand Mean		3.06	10.11	11.66	103.29	273.53	8.17	289.54	545
	St.Dev.	0.17	1.94	0.49	3.37	11.79	0.07	2.05	

TABLE 10
TORONTO HARBOUR 1975
WATER CHEMISTRY DATA SUMMARY

Location	Meter Type	Period of Operation	# of Readings	Recording Interval (min)	Chloride mg/l		Temperature °C		Dissolved Oxygen Turbidity, FTU mg/l		% sat.		or Redox Pot* MV		pH		Conductivity umho/cm	
					Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
East Gap	Sch. Robot	Oct 24-Nov 7	263	60	-	-	11.1	1.1	10.0	0.3	92	3	5.9	5.0	7.9	0.2	337	6
	" "	Nov 7-Dec 5	2010	20	-	-	8.1	2.1	10.3	1.1	86	6	8.3	3.8	8.0	0.1	338	5
	Plessey WQM 4	Nov 24-Dec 16	474	60	-	-	4.8	1.3	12.8	0.3	100	3	-	-	-	-	341	15
West Gap	Sch. Robot	Oct 30-Nov 7	193	60	-	-	9.5	0.3	10.2	0.3	89	6	3.8	2.9	8.1	0.1	320	3
	" "	Nov 7-Dec 5	2000	20	-	-	6.0	1.9	11.2	0.5	90	3	5.2	3.5	8.1	0.1	328	9
Keating Channel	" "	Oct 31-Nov 7	171	60	191	53	11.7	1.7	7.7	1.8	70	14	-	-	7.9	0.7	608	130
	" "	Nov 7-Nov 20	935	20	92	58	10.4	2.1	7.1	1.8	63	15	-	-	7.9	0.2	509	158
	" "	Nov 27-Dec 5	573	20	-	-	5.2	1.3	11.0	0.7	86	5	-	-	7.7	0.1	530	178
	" "	Dec 5-Dec 8	80	60	-	-	4.5	1.2	11.3	0.4	87	2	-	-	7.7	0.1	691	369
Central Harbour	NERA	Nov 6-Nov 17	481	30	-	-	9.1	1.5	11.2	0.3	97	3	234*	15*	7.9	0.1	335	6
	"	Nov 21-Nov 27	282	30	-	-	6.2	0.5	11.5	0.2	93	2	241*	18*	8.0	0.1	349	5
Canada Malting	"	Nov 13 (6 hr)	36	10	-	-	9.6	0.1	10.5	0.4	92	3	156*	9*	8.1	0.1	300	7
Queen Elizabeth Dock	"	Nov 24 (6 hr)	184	2	-	-	7.3	0.1	13.3	0.5	110	5	112*	14*	7.8	0.1	344	4

TABLE 11
TORONTO HARBOUR 1976
WATER CHEMISTRY METER DATA SUMMARY

Location	Meter Type	Period of Operation	# of Readings	Recording Interval (min)	Chloride mg/l		Temperature °C		Dissolved Oxygen Turbidity, FTU mg/l		% sat.		or Redox Pot.* MV		pH		Conductivity umho/cm	
					Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
East Gap	Sch. Robot	Jun 17-Jun 28	768	20	-	-	14.8	2.3	10.8	1.3	107	11	5.7	2.3	8.5	0.3	334	11
	" "	Jun 30-Jul 20	1406	20	-	-	12.6	2.1	11.1	1.1	103	100	5.4	2.4	-	-	333	11
	" "	Jul 20-Aug 5	1156	20	-	-	15.0	2.9	9.4	2.4	91	23	3.3	2.9	-	-	327	13
	" "	Aug 5-Aug 20	755	20	-	-	17.2	1.1	9.0	1.1	93	13	3.8	1.8	-	-	331	7
West Gap	" "	Jul 7-Jul 13	361	20	-	-	7.5	1.9	11.9	0.4	99	6	2.0	0.5	8.3	0.2	334	8
	" "	Jul 16-Jul 20	208	20	-	-	6.8	0.5	12.2	0.4	99	4	2.4	2.3	8.3	0.2	337	12
	" "	Jul 21-Jul 29	553	20	-	-	9.0	1.3	11.8	0.9	98	10	4.4	1.4	7.9	0.4	348	13
Keating Channel	" "	Jun 17-Jun 30	951	20	105	26	16.9	2.5	6.3	1.8	65	17	-	-	-	-	503	127
	" "	Jun 30-Jul 6	435	20	128	26	17.8	1.1	5.1	1.1	53	12	-	-	-	-	596	126
	" "	Jul 7-Jul 11	291	20	143	46	17.2	2.6	4.1	2.0	42	19	-	-	-	-	658	181
	" "	Jul 12-Jul 20	578	20	100	21	12.6	1.7	6.6	1.6	61	14	-	-	-	-	487	98
	" "	Jul 20-Jul 30	722	20	89	35	14.1	3.0	8.0	1.9	76	16	-	-	-	-	456	140
	" "	Aug 5-Aug 18	956	20	152	35	19.1	1.3	3.8	1.6	41	17	-	-	7.5	0.2	673	148
End of Turning Basin Channel	NERA	Aug 31 (8 hr)	49	10	-	-	16.0	1.5	8.2	0.2	83	3	269*	9*	8.1	0.1	347	5
Queen Elizabeth Docks	"	Sept 1 (8 hr)	44	10	-	-	15.3	1.0	7.8	0.4	77	2	202*	31*	8.0	0.1	456	88
Canada Malting	"	Sept 2 (8 hr)	42	10	-	-	14.7	0.5	9.9	1.1	97	11	230*	13*	8.2	0.1	354	4

FIGURE 12
HAMILTON HARBOUR 1976
WATER CHEMISTRY PROFILING SUMMARY (1 meter increments)

DATE	STATIONS SAMPLED	TEMPERATURE	DISSOLVED OXYGEN	OXIDATION REDUCTION POTENTIAL	PH	CONDUCTIVITY
April 8	270, 258, 4.	A	A	A	A	A
April 15	270, 258, 4	A	A	U	U	U
April 23	270, 258, 4, 252	A	A	U	U	U
April 30	270, 258, 4, 252	A	A	A	A	A
May 13	270, 258, 4, 252	A	A	A	A	A
May 27	270, 258, 4, 252	A	A	A	A	A
June 4	270, 258, 4, 252, 262, 256, 20, 269, 257	A	A	A	A	A
June 11	270, 258, 4, 252	A	A	A	A	A
June 18	270, 258, 4, 252	A	A	A	A	A
June 22	270, 258, 4, 252, 262, 256, 20, 269, 257	A	A	A	A	A
June 25	270, 258, 4, 252	A	A	A	A	A
July 6	270, 258, 4, 252, 1000	A	A	A	A	A
July 19	270, 258, 4	A	A	A	A	A
July 22	270, 258, 4	A	A	A	A	A
July 26	270, 258, 4, 252, 262, 256, 20, 269, 257	A	A	A	A	A
Aug. 6	270, 258, 4, 252, 1000	A	A	A	U	A
Aug. 13	270, 258, 4, 252, 1000	A	A	A	A	A
Aug. 20	270, 258, 4, 252	A	A	A	A	A
Aug. 26	270, 258, 4, 252	A	A	A	A	A
Sept. 3	270, 258, 4, 252	A	A	A	A	A
Sept. 8	270, 258, 4, 252	A	A	A	A	A
Sept. 16	270, 258, 4, 252	A	A	A	A	A
Sept. 24	270, 258, 4, 252	A	A	A	A	A
Sept. 30	270, 258, 4, 252	A	A	A	A	A
Oct. 7	270, 258, 4, 252, 262, 256, 20, 269, 257, 264, 15 261, 259, 254, 260, 253, 268, 255	A	A	A	A	A
Oct. 14	270, 258, 4, 252	A	A	A	A	A
Oct. 22	270, 258, 4, 252	A	A	A	A	A
Oct. 27	270, 258, 4, 252	A	A	A	A	A

N.B. A = Available U = Unavailable

TABLE 13 HAMILTON HARBOUR STATION NO. 270

1976 PARAMETER SUMMARY

Depth M	Temperature (°C)			D.O. mg/l			ORP mV			pH			COND. umhos/cm		
	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples
0-1	18.2	3.0	33	7.4	3.0	33	168	36	31	7.8	0.4	30	506	46	31
1-2	15.7	4.9	35	8.2	3.0	35	169	43	33	7.9	0.5	32	495	47	34
2-3	16.2	4.7	31	7.8	3.3	31	175	42	30	7.8	0.6	28	505	47	30
3-4	15.8	4.7	29	7.6	3.4	29	180	31	28	7.9	0.5	26	499	44	28
4-5	15.7	4.3	28	7.1	3.3	28	177	40	27	7.8	0.5	25	499	47	27
5-6	15.5	3.9	27	6.0	3.2	27	182	47	27	7.7	0.5	26	497	48	27
6-7	14.8	4.0	29	6.3	4.3	29	188	39	27	7.7	0.5	26	492	44	27
7-8	14.9	3.8	30	5.8	4.1	30	186	46	29	7.7	0.5	29	494	45	29
8-9	14.6	3.8	27	5.1	4.3	27	190	40	25	7.7	0.5	26	486	40	26
9-10	13.8	3.7	29	5.3	4.6	29	184	46	28	7.6	0.5	27	489	44	28
10-11	13.4	3.1	29	4.3	4.6	28	184	46	28	7.5	0.5	27	481	44	28
11-12	12.9	2.9	27	3.7	4.8	27	178	36	26	7.6	0.6	25	472	39	26
12-13	12.5	2.5	29	3.5	4.8	28	151	50	28	7.5	0.5	27	475	44	28
13-14	11.4	2.3	21	3.6	5.2	21	129	57	18	7.6	0.6	20	494	41	20
14-15	7.4	0.9	6	12.5	3.1	6	148	19	3	8.5	0.2	4	477	36	4

TABLE 14 HAMILTON HARBOUR STATION NO. 258

1976 PARAMETER SUMMARY

Depth M	Temperature (°C) Mean	St.Dev.	No. of Samples	D.O. mg/l Mean	St.Dev.	No. of Samples	ORP mV Mean	St.Dev.	No. of Samples	pH Mean	St.Dev.	No. of Samples	COND. umhos/cm Mean	St.Dev.	No. of Samples
0-1	17.6	4.4	35	8.1	1.9	35	155	58	33	8.0	0.4	33	505	57	33
1-2	16.7	5.2	29	9.0	2.1	29	156	37	28	8.1	0.5	26	504	51	28
2-3	16.4	4.6	28	8.5	2.1	28	163	50	27	8.0	0.5	26	501	52	27
3-4	16.2	4.5	27	7.8	2.3	27	167	33	26	7.9	0.5	25	502	52	26
4-5	15.9	4.4	26	7.7	2.4	26	163	41	25	7.9	0.6	24	503	50	25
5-6	15.6	4.3	26	7.3	2.7	26	165	42	25	7.8	0.5	24	501	47	25
6-7	15.4	4.2	25	6.8	3.3	25	176	37	24	7.7	0.5	21	495	45	24
7-8	14.5	3.7	26	6.1	3.6	26	173	43	25	7.7	0.5	24	493	46	25
8-9	14.4	3.6	25	5.5	3.8	25	180	36	24	7.6	0.5	23	489	42	24
9-10	13.7	3.1	28	5.4	3.9	28	176	44	27	7.6	0.5	26	480	43	27
10-11	13.5	2.9	26	4.6	4.2	26	178	45	25	7.6	0.5	24	482	43	25
11-12	13.0	2.6	27	4.7	4.3	27	182	39	26	7.6	0.5	25	475	48	26
12-13	12.8	2.5	26	4.4	4.4	26	180	51	25	7.6	0.5	24	474	46	25
13-14	12.3	2.4	23	4.4	4.5	23	182	55	22	7.6	0.5	21	477	47	22
14-15	12.5	2.3	27	3.8	4.6	27	188	45	25	7.5	0.5	25	481	54	26
15-16	12.2	2.2	27	4.1	4.5	27	178	50	26	7.5	0.5	25	471	46	26
16-17	11.9	2.2	23	4.4	4.7	23	173	43	22	7.6	0.5	22	482	53	22
17-18	12.0	2.2	26	3.9	4.6	26	190	58	25	7.6	0.5	22	478	51	25
18-19	11.2	2.2	14	4.5	4.5	14	171	47	14	7.6	0.5	14	492	57	13
19-20	12.0	0.9	13	2.9	3.4	13	187	59	13	7.4	0.3	12	493	57	13
20-21	12.0	0.9	12	2.8	3.5	12	195	47	12	7.4	0.3	11	489	58	12
21-22	11.7	0.9	20	3.0	3.1	20	192	56	18	7.4	0.3	17	482	54	20
22-23	11.7	0.7	12	0.5	1.8	12	173	40	11	7.3	0.1	12	528	45	12

TABLE 15 HAMILTON HARBOUR STATION NO. 4

1976 PARAMETER SUMMARY

Depth M	Temperature (°C)			D.O. mg/l			ORP mV			pH			COND. umhos/cm		
	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples
0-1	19.4	3.3	31	7.6	1.8	31	170	49	30	7.8	0.3	29	535	63	30
1-2	17.8	5.1	30	8.1	2.1	30	172	48	29	7.9	0.4	26	528	53	29
2-3	17.7	4.4	29	7.6	2.3	29	170	38	28	7.8	0.3	26	521	53	28
3-4	17.6	4.6	26	7.7	2.1	26	175	37	25	7.8	0.3	23	518	54	25
4-5	16.6	4.5	23	7.5	2.5	23	170	43	22	7.8	0.4	19	521	58	22
5-6	16.5	4.1	26	6.9	2.9	26	176	41	25	7.8	0.4	23	511	53	25
6-7	16.8	4.2	27	6.9	2.9	27	177	36	26	7.8	0.4	25	512	51	26
7-8	15.7	3.8	26	6.3	3.5	26	178	42	24	7.8	0.5	24	502	51	25
8-9	15.3	3.9	23	6.3	3.7	23	181	38	22	7.8	0.5	21	493	49	22
9-10	14.8	3.5	24	4.9	4.2	24	178	41	23	7.7	0.5	22	500	55	23
10-11	14.3	3.4	25	5.2	4.1	25	178	40	24	7.7	0.5	22	490	50	24
11-12	13.6	2.7	25	4.0	4.0	25	185	36	25	7.6	0.5	23	489	53	25
12-13	13.4	2.6	25	4.7	4.1	25	179	43	24	7.6	0.5	23	472	48	24
13-14	12.5	2.1	24	4.4	4.3	24	181	46	23	7.6	0.5	22	481	57	23
14-15	12.5	2.2	25	4.2	4.5	25	180	32	24	7.6	0.5	24	472	55	24
15-16	12.3	1.9	27	4.3	4.5	27	180	47	26	7.6	0.4	24	478	56	26
16-17	11.8	2.1	25	4.7	4.6	25	175	45	24	7.7	0.5	22	474	57	24
17-18	12.0	1.7	23	4.5	4.1	23	183	30	22	7.6	0.4	22	470	53	22
18-19	11.5	1.7	13	4.0	3.6	13	160	59	13	7.7	0.5	13	495	61	13
19-20	11.9	0.7	12	3.2	3.1	12	163	64	12	7.5	0.3	11	496	59	12
20-21	11.6	0.4	6	2.8	2.4	6	115	27	4	7.6	0.2	6	546	50	6
21-22	12.9	0.6	3	5.3	4.6	3	150	44	3	7.6	0.2	3	468	54	3

TABLE 16 HAMILTON HARBOUR STATION NO. 252

1976 PARAMETER SUMMARY

Depth M	Temperature (°C)			D.O. mg/l			ORP mV			pH			COND. umhos/cm		
	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples	Mean	St.Dev.	No. of Samples
0-1	18.7	3.3	28	8.6	2.1	29	168	30	28	8.0	0.4	27	504	63	28
1-2	17.2	4.3	29	8.6	2.1	29	175	56	28	7.9	0.5	26	496	50	28
2-3	17.3	3.7	23	8.0	2.5	22	176	37	22	7.9	0.5	21	5003	50	22
3-4	17.3	3.7	22	7.6	2.8	22	187	30	21	7.7	0.5	20	499	46	21
4-5	16.8	3.7	22	7.1	2.4	22	182	37	21	7.7	0.4	20	510	53	21
5-6	16.4	3.4	24	6.2	2.6	24	190	29	23	7.6	0.4	22	500	50	23
6-7	16.0	3.2	28	5.8	3.0	28	180	35	27	7.5	0.4	26	504	66	27
7-8	13.9	3.4	13	5.5	4.1	13	128	53	12	7.6	0.6	11	518	56	12
8-9	12.3	3.5	3	7.4	4.5	3	159	0	1	7.8	0.7	2	533	57	2